

means for recovering condensed elemental sulfur from said cooling means; and  
means for recovering a stream of desulfurized synthesis gas.

27. (New) The apparatus of claim 26 comprising means for removing residual elemental sulfur from said desulfurized synthesis gas stream.

28. (Amended) The apparatus of claim 26 wherein said means for maintaining the temperature of said reaction zone above the dew point of sulfur comprises means for maintaining the temperature of said reaction zone above 500 degrees C.

#### REMARKS

Applicants acknowledge receipt of the Office Action mailed February 4, 2002. In that Office Action, the Examiner (1) asserted a restriction requirement and required affirmation of the provisional election made on August 2, 2001; (2) rejected certain claims under 35 U.S.C. § 112, second paragraph; (3) rejected certain claims under 35 U.S.C. § 102(b) based on *De Jong et al.*; and (3) rejected certain claims under 35 U.S.C. § 103(a) based on *De Jong et al* and *Dubois et al.*

#### Status of Claims

Claims 8 and 9 have been amended. A marked up version of the amended claims, showing the changes by underlining of the added text and striking out the deleted text, is appended hereto.

Claims 1-7, 13 and 18-20 have been canceled.

New claims 21-28 have been added.

#### Election/Restrictions

Applicant affirms election of Restriction Group II (claims 8-16) for prosecution in the present application. Accordingly, the non-elected Group I claims (1-7 and 18-20) have been canceled, above. Claim 17, which depends from claim 8, would likely have been included among the Group II system claims in the restriction notice were it not for a typographical error in the claim's preamble. In the Preliminary Amendment filed on January 8, 2002 claim 17 was corrected to recite "system" instead of "method." Applicant believes that claim 17 is now properly included among the elected Group I system claims and respectfully requests examination of that claim.

Rejection of Claims under 35 U.S.C. § 102(b)

In the Office Action, claims 8, 9, 11, 12, 14 and 15 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,720,901 (*De Jong et al.*). The Examiner states, with respect to claim 8, that *De Jong et al.* disclose a system comprising "a hydrocarbon, a hydrogen sulfide, and an oxygen injection line in communication with each other" and concludes that "[i]f they have to be mixed together, it is inherent that they are introduced separately" (underlining added for emphasis). Applicant respectfully traverses that conclusion, for the reason that it is unclear in *De Jong et al.* how hydrocarbon, H<sub>2</sub>S, oxygen, and, optionally, steam are combined. See *De Jong et al.* at col. 5, lines 11-16, for instance, where it states that "[i]f natural gas or associated gas are being employed, sulfur-containing compounds may be present in the gas as it is produced from the reservoir." [underlining added for emphasis]

Claim 8 has been amended to state that the catalyst included in the reaction zone is suitable for catalyzing the partial oxidation of the hydrocarbon and is suitable for catalyzing the partial oxidation of H<sub>2</sub>S, to form a reaction product containing CO, H<sub>2</sub>, elemental sulfur and H<sub>2</sub>O. Irrespective of how the hydrocarbon, oxygen and sulfur-containing compound might be combined in *De Jong et al.* to make up a reactant gas mixture, the system of Applicant's amended claim 8 distinguishes over this reference because *De Jong et al.* only requires a catalyst composition suitable for use in the catalytic partial oxidation of hydrocarbons, as known in the art. Clearly, in *De Jong et al.*, there is no mention of partial oxidation of H<sub>2</sub>S occurring over the same catalyst in the same reaction zone where the partial oxidation of the hydrocarbon occurs. Only prior art methods are envisioned by *De Jong et al.* for removing sulfur-containing compounds. When the sulfur content of a hydrocarbon feedstock is significantly above the limits specified by *De Jong et al.* (at Col. 5, lines 17-22), the feedstock may be subjected to a partial sulfur removal treatment before being employed in the syngas production process (Col. 5, lines 26-31). *De Jong et al.* also describe sulfur removal that is performed in a conventional manner after completion of the hydrocarbon partial oxidation reaction. The sulfur-containing component exits the reactor with the CO and/or H<sub>2</sub> product and

"[a] product stream comprising carbon monoxide and hydrogen is withdrawn from the process via line 18 to be employed as a feed for sulfur-tolerant applications (not shown). A portion of the cooled product stream is supplied via line 20 to desulfurization unit 22. A substantially sulfur-free product stream is removed from the desulfurization unit 22 via line 24 for supply to sulfur-sensitive applications." (Col. 8, lines 13-17)

"Suitable processes for use in the desulfurization unit for removing sulfur-containing components from the carbon monoxide/hydrogen product are well known in the art. Suitable techniques include adsorption of the sulfur-containing compounds by passing the product stream through a bed of a suitable adsorbent, for example active carbon or zinc oxide." [underlining added for emphasis] (Col. 8, lines 21-27)

For at least these reasons, independent claim 8 and claims 9-17 which depend directly or indirectly therefrom, distinguish over *De Jong et al.* Even if, for the sake of argument, *De Jong et al.* did teach a mixing zone upstream from the reaction zone (as in claim 9), an oxygen line that communicates with the reaction zone (as in claim 11), a mixing zone that receives oxygen from an oxygen injection line (as in claim 12), at least one cooling zone downstream from the reaction zone (as in claim 14), and a tailgas processing unit (as in claim 15), *De Jong et al.* would still fail to provide Applicant's invention as described in claims 8, 9, 11, 12, 14 and 15.

#### Rejection of Claims under 35 U.S.C. § 103(a)

In the Office Action, claim 10 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 5,472,920 (*Dubois et al.*). The Examiner suggests that it would be obvious to combine a thermal barrier as described in *Dubois et al.* between the mixing and reaction zones in *De Jong et al.* In reply, Applicant respectfully submits that even if the thermal barrier of *Dubois et al.* were combined as proposed by the Examiner for the stated reasons, one still would not have the invention of claim 10 because *De Jong et al.* does not disclose the reactor of amended claim 8, from which claim 10 indirectly depends. The mere addition of a thermal barrier to the reactor of *De Jong et al.* would not correct the deficiencies of the resulting apparatus, as described above with respect to the rejection under 35 U.S.C. § 102(b).

Claim 16 also stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *De Jong et al.* in view of U.S. Patent No. 5,654,491 (*Goetsche et al.*). The Examiner suggests that it would be obvious to provide a wire gauze as described in *Goetsche et al.* as a catalyst support for the catalyst in *De Jong et al.* Even if the wire gauze of *Goetsche et al.* were combined as proposed by the Examiner, one still would not have the invention of Applicant's claim 16 because *De Jong et al.* does not disclose the reactor of amended claim 8, from which claim 16 depends. The mere addition of a wire gauze catalyst support to the reactor of *De Jong et al.* would not make up the differences between Applicant's system of amended claim 8 and the reactor and sulfur removal unit

arrangement of *De Jong et al.*, as discussed above with respect to the rejection under 35 U.S.C. § 102(b).

#### Rejection of Claims Under 35 U.S.C. § 112, Second Paragraph

Claims 9-13 stand rejected under 35 U.S.C. § 112, second paragraph as being indefinite. The Examiner suggests that claim 9 improperly recites a temperature limitation. In reply, claim 9 has been amended to omit the temperature limitation. For better clarity, claim 9 has been further amended to require that the mixing zone is adapted for receiving the hydrocarbon, H<sub>2</sub>S and O<sub>2</sub> gases. Claims 10-12, which depend from claim 9, are now also believed to comply with § 112, second paragraph. Claim 13 has been canceled and some of its subject matter has been included in new claim 28.

#### New Claims

New claims 21-28 have been added to better ensure coverage of specific embodiments to which Applicant is entitled. The subject matter of these claims is supported in the original claims, specification, and or drawings. For example, in the Specification at page 10, lines 8-17 and Figure 2 (claims 21, 22, 24 and 25); at page 6, lines 3-10 and page 8, lines 4-8 (claim 23); the entire Detailed Description on pages 5-11 and Figures 1 and 2 (claims 26-28).

#### Conclusion

Applicants may have at times referred to claim limitations in shorthand fashion, or may have focused on a particular claim element. This discussion should not be interpreted to mean that the other limitations can be ignored or dismissed. The claims must be viewed as a whole, and each limitation of the claims must be considered when determining the patentability of the claims. Moreover, it should be understood that there may be other distinctions between the claims and the prior art, which have yet to be raised, but which may be raised in the future.

Consideration of the foregoing amendments and remarks, reconsideration of the application and withdrawal of the rejections and objections is respectfully requested by Applicant. No new matter is introduced by way of the amendments. It is believed that each ground of objection and rejection raised in the Office Action dated February 4, 2002 has been fully addressed. However, if a telephone conference would facilitate the resolution of any issue, the Examiner is invited to

telephone the undersigned at (713) 238-8000. If any fee is due as a result of the filing of this paper, please appropriately charge such fee to Deposit Account Number 03-2769.

Respectfully submitted,

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## MARKED-UP VERSION OF THE AMENDMENTS

8. (Amended) A system for the partial oxidation of light hydrocarbons and the partial oxidation of H<sub>2</sub>S, comprising a hydrocarbon injection line, an H<sub>2</sub>S injection line in communication with said hydrocarbon injection line, an oxygen injection line in communication with said hydrocarbon injection line, a reaction zone for receiving gases from said hydrocarbon, H<sub>2</sub>S and oxygen injection lines and including a catalyst suitable for catalyzing the partial oxidation of said hydrocarbon and the partial oxidation of H<sub>2</sub>S to form CO<sub>2</sub> ~~and H<sub>2</sub>~~, elemental sulfur and H<sub>2</sub>O.

9. (Amended) The system according to claim 8 comprising a mixing zone upstream of said reaction zone, said mixing zone adapted for receiving gases ~~from said hydrocarbon, and said H<sub>2</sub>S, and oxygen gases lines, wherein the temperature of said mixing zone is less than 500 degrees C.~~

21. (New) The system of claim 8 comprising, in sequence:

a synthesis gas reactor having a light hydrocarbon gas inlet, an O<sub>2</sub> inlet and an H<sub>2</sub>S inlet,

a firetube boiler,

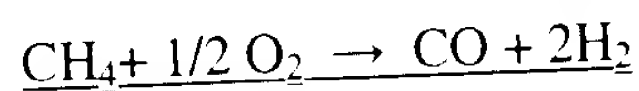
a sulfur condenser,

a heater, and

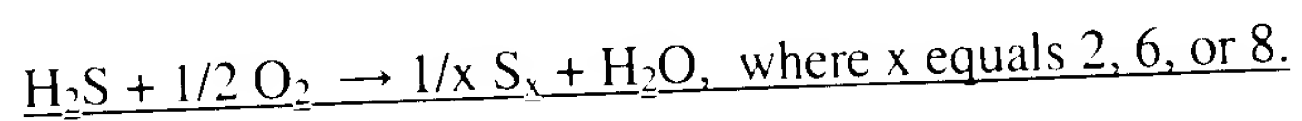
a tailgas cleanup unit.

22. (New) The system of claim 21 further comprising, in sequence, a cooler for receiving product gas from said tailgas cleanup unit, and a quench tower.

23. (New) The system of claim 8 wherein said catalyst is active for catalyzing the reactions



and



24. (New) The system of claim 14 wherein said cooling zone comprises a sulfur condenser.



25. (New) The system of claim 15 wherein said tailgas processing unit comprises a sulfur absorbing material.

26. (New) An apparatus for producing synthesis gas and elemental sulfur, the apparatus comprising:

means for effecting both the catalytic partial oxidation of a light hydrocarbon to form CO and H<sub>2</sub> products and the catalytic partial oxidation of H<sub>2</sub>S to elemental sulfur and H<sub>2</sub>O in a single reaction zone of a short contact time reactor, whereby a stream of product containing CO, H<sub>2</sub>, H<sub>2</sub>O and elemental sulfur is produced;

means for maintaining the temperature of said reaction zone above the dew point of sulfur,

means for cooling said product stream below the dewpoint of sulfur;

means for recovering condensed elemental sulfur from said cooling means; and

means for recovering a stream of desulfurized synthesis gas.

27. (New) The apparatus of claim 26 comprising means for removing residual elemental sulfur from said desulfurized synthesis gas stream.

28. (Amended) The apparatus of claim 26 wherein said means for maintaining the temperature of said reaction zone above the dew point of sulfur comprises means for maintaining the temperature of said reaction zone above 500 degrees C.